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ABSTRACT

Technology has a key role in the latest educational reform in which the focus has shifted from what should be taught to how it should be taught. In general, computers in New Zealand schools, particularly secondary schools, are not integrated into classrooms. Lack of funding has resulted in schools buying computers almost entirely from funds raised by local communities. Implementation of technology in New Zealand schools has not only lacked consistent central direction, but also the provision of resources, curriculum development, professional development, and coordinated expertise sharing. School and classroom organizational structures, the way the curriculum is organized, assessment practices, and teachers' attitudes impact on the overall response to educational innovations. Saturating schools with technology and teachers with professional development may not bring about reform until the present traditional idea of schooling is discarded. (Contains 47 references.) (AEF)

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ED 390 375

DIFFERENT PATHS TO THE INFORMATION HIGHWAY: FACTORS AFFECTING IMPLEMENTATION OF COMPUTERS IN NEW ZEALAND SCHOOLS

Symposia Title: "New Zealand Education and its Reforms: Lessons from a social laboratory".

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School reform and technological initiatives are linked. It is seen as necessary for schools to be more responsive to the needs of the economy and to provide the type of education which equips students to work in a technological age. It is also seen as necessary for schools to reform in order to meet changed needs and technology may provide the catalyst for transforming existing practices. "Computers and the new technology have been seen as something of a savior economically and pedagogically" (Apple, 1991, p.60).

For policy makers and governments restructuring is to make education more responsive to the community, including the economic community. In New Zealand, important philosophical changes in education have been seen in the administrative changes involving devolution of reponsibility to the school level and the new openness of the school to the community. Responsiveness to economic needs includes raising student achievement, particularly in science, maths and technology. The present Secretary of Education sees the use of information and communications technology as a strategy for this (O'Rourke, 1994). In such statements, there can be an element of technocentric thinking, the belief that sophisticated technology will somehow act directly to raise student achievement (Ryba, 1991).

There have been expanding expectations of schools, in terms of educating a workforce for a technological age, which have produced, among some administrators, the mental set that they must be seen to be doing something and putting machines in the

restructuring, that is constructing new buildings and stocking them with the latest high tech products. Rather, he writes, restructuring involves (amongst other things) changes with respect to training of teachers; teacher-student ratio; professional responsibilities, self image and expectations; timetabling of school day and year; the ways schools are financed; the way parents choose schools; the administrative structure; the curriculum, in fact, the very purpose of schools.

For educators, central to reform is the aim of improving teaching and learning. The latest reform is in terms of a shift in focus from content of what should be taught to how it should be taught- pedagogy- and here technology has a key role (Stoddart & Niederhauser, 1993). It is generally accepted that technology has potential as an agent of change and could lead to a restructuring of schools as they adapt to technology (Collins, 1991). The belief is that technology, used appropriately, will promote the restructuring movement towards student centered approaches where both the cognitive and the social construction of knowledge are recognised and this will improve teaching and learning (Office of Technology Assessment, 1988). The New Zealand Secretary for Education echoed the sentiment that, used appropriately, information technology (IT) will lead to changes in teaching and learning (O'Rourke, 1994). Hopefully, as Hodson (1990) observes, appropriately is interpreted as using computers in emancipatory ways to support personalised learning and not to instruct and to direct learning.

Reform in education does not necessarily lead to change in classrooms. Stoddart and Niederhauser (1993) point out that, in the United States, education has gone through

recurring cycles of reform but little has changed either in the way children are taught or in the way they are expected to learn. Educational innovations will not necessarily be implemented, work as intended or become widespread. Mecklenberger (1990) notes that virtually every classroom application of information technology can be seen somewhere in the United States (and this is probably true of New Zealand and Australia too) but, despite this, chalk and talk, texts and notes dominate almost everywhere. Perhaps it is, as Collins (1991) suggests, only when a technology becomes widespread that it has ramifications. We are not far from this point now and what has become apparent is that a complex web of interrelated factors affect successful implementation, innovation and change (Strudler, 1993).

The implementation of technology in educational settings has taken several different paths. D'Ignazio (1992) talks of "soft architecture" and "hard architecture" for restructuring. "Soft architecture" involves new ways of organising classroom learning, for example, using multi media tools. A different mode of restructuring is using "hard architecture", that is "connecting class buildings to regional networks, fiber optic cabling, server rooms adjoining classrooms, television in each classroom, phone lines for e-mail and more costly restructuring measures" (D'Ignazio, 1992, p.54). There are potentially a number of factors which could influence the process of implementation and of change. These include the characteristics of the technology; of the participants, and of the school and education system (Honey & Moeller, 1990).

In New Zealand, the contrast in modes of implementation is not dramatic but there is evidence of D'Ignazio's (1992) dichotomy. The historical context in which computers

first appeared in New Zealand schools influenced much of the subsequent implementation. In general, computers in New Zealand schools, particularly secondary schools, are not integrated into classroom practice to any great extent. In common with many other educational systems, computers first made their appearance in the maths area as a part of a Year 12 course in applied mathematics then, in 1982, as a Year 11 subject "Computer Studies". For many this was the guiding rationale for computers in schools. In 1990 still about 90 percent of secondary schools reported that "computers" were a separate course (Nightingale & Chamberlain, 1990). They are also often incorporated into a section of the course in other curriculum subjects as part of the move to make computers accessible and visible across the curriculum.

Secondary schools began before their primary counterparts to acquire computers to support the new curriculum subject. They tend to have many more machines per school and, unlike in primary schools where national growth in total number of machines is accounted for by more schools acquiring them, the number per secondary school continues to grow (Nightingale & Chamberlain, 1990). Computer labs are the preferred location for machines in secondary schools. They are the norm in about three quarters of them (Nightingale & Chamberlain, 1990), although many now have, in addition, a non timetabled room (e.g. Nielson, 1991). This choice of location may be partly a result of the fact that Government funding was made available in the mid eighties to upgrade classrooms to computer labs. In primary schools it is most common to find one or two computers in each classroom, either permanently or on a time share basis. The two sectors, primary and secondary, have evolved quite different approaches to implementation, partly as a consequence of differences in

timing of onset; of different curriculum needs and organisational structures; differing resources and priorities but also because of differences in teacher training and beliefs about the nature of teaching and learning.

The growth of computers and associated technology in schools has not come about as a result of strong central direction, intervention or provision of resources. In the early years of implementation, the Ministry of Education was closely involved, entering into a joint venture to produce a local computer, then contracting an evaluation of existing hardware and software and setting up a Computer Courseware Development Unit which, shortly thereafter, reflected a changing situation by becoming the Computers in Education Development Unit (CEDU). Money was allocated for exploratory studies to help determine the best ways of using computers in New Zealand schools. Then in 1989, the CEDU was disestablished and, in line with subsequent reforms, responsibility for integrating computers into the curriculum devolved to individual schools while six district computer advisors were appointed to colleges of education. In 1990, educators were asking "Where is the government commitment?" (Hilton, 1991) as advisors were stretched and schools struggled to both fund and implement programmes involving computers in education. The Sallis Report (Consultative Committee for Computers in Education), released late 1990, dealt briefly with "issues" and spent a substantial time examining the cost of its foremost recommendation, the upgrading of teacher development. The "astonishingly low level of computer literacy amongst the teaching force" was considered a significant factor, hindering the creation of a coherent national policy concerning computers in education (Hodson, 1990, p.7). Ministry response in 1991-2 was to initiate teacher development

programmes with the aim of getting a critical mass of teachers confident and competent IT users (see Gilmore, 1994), a programme which has been, subsequently, scaled down. The lack of naticnal policy and lack of government commitment have contributed to the difficulties associated with implementing computers in education.

Lack of funding for hardware and software has meant that schools have bought these items almost entirely from funds raised by local communities (Wakefield, 1994). There has been little funding for curriculum development and for widespread teacher training or coordinated sharing of expertise, with much duplication of effort resulting (Hodson, 1990, 1992). A recent study (Wakefield, 1994) suggested that, at the school level, there has been little planning in terms of financial provision for maintenance or upgrading of hardware or for professional development, and software budgets have remained small.

Planning is a vital factor in change. "Identifying the problem to be solved, negotiating decisions, integrating all elements of the plan, and sustaining new roles and patterns of authority are key components of effective change", according to Levinson (1990, p.125). It has been suggested that a major reason why the technology revolution has failed to touch schools is because often purchases have preceeded planning (Boyer, 1983). There is evidence in New Zealand, particularly in the early stages of implementation, of a lack of knowledge of how computers would work in the educational process. "The PTA, the principal and the staff had little idea of what a computer could do for the children" stated a booklet of case studies produced by a group of teachers in 1986. In the same publication there was an illustration of, quite

aptly, an ape, scratching head and asking "What are its uses in my school?" (Kohia Teachers Centre, 1986). This sums up the mentality, still evident, of a solution looking for a problem. Often it seems that computers were purchased as a result of parents' (and students') enthusiasm and the idea of giving students experience they will need in the future (Nightingale & Chamberlain, 1990) rather than employing computers to support teaching and social practices needed to solve an educational problem (Ryba, 1991). This lack of planning is further illustrated by data which records 63 per cent of computer using primary schools as having no written policy or statement with respect to the use of computers for teaching or learning (Nightingale & Chamberlain, 1990).

There has not always been the necessary close integration between technical, organisational and educational issues in implementing computers in education (Levinson, 1990). The lack of knowledge, of clear direction, problem identification and planning has meant that many schools have gone down blind alleys like Gestetner Lane, Commodore Close and Wang Place before connecting with a route to the main highway, their maps, often labelled "Computer Literacy" and their direction finders (leaders) inadequate. The factors discussed above arise from a general consideration of the process of implementation of computers into New Zealand schools. Amplification and evidence of additional factors comes from a more detailed consideration of specific cases, selected to represent different implementations and approaches to the use of computer technology.

The present educational uses of computers and the uses envisaged for the future, fall into three broad categories, according to Silverman (1991). The first category involves

a new curriculum, describing a new technology and its application and implications. Although most secondary schools have followed this path of computer studies courses and computer literacy courses (the latter in a few primary schools too), the brief compulsory dose is often followed by further exposure through what could loosely be termed computers across the curriculum.

Generally this use across the curriculum falls within the second category Silverman (1991) notes which is use of the computer as a new way to present the same material. Most obvious is the use of drill and practice software or content based software. However, the use of tool software like data bases or the use of word processing as a tool for writing can also fit this category, depending on the approach of the teacher. The first case study examines the implementation of an integrated learning system, a form of computer assisted learning. The second case study provides an example of how difficult it is, even in a technology rich school, to move much beyond this idea of presenting material in a new way, to a stage where there is change in the way education is conducted. To do this would be to move towards new kinds of curriculum and new kinds of education, Silverman's third category, and the final case studies provide glimpses of schools both having tried or beginning on this route.

There are basically three possible outcomes of an innovation according to Levinson (1990): mutual adaption in which both the organisation and the innovation undergo change; co-option in which the school system uses the innovation to further its own purposes and technical implementation in which the innovation is in place but not fully used. There are elements of these outcomes in the case studies of implementation

discussed below.

This paper represents a synthesis. In part it draws on the author's original empirical research, placing it in a wider context using other published and unpublished works. In the schools which provide examples of differing modes of implemetation, the process of implementation is essentially treated as a case study and data has been gathered from those participating from interview, self report, school work products and from observation (both formal and informal).

A new way to present the same material: The use of an integrated learning system.

The use of an integrated learning system (ILS) is generally seen to involve few changes in both the content and the way the school delivers education (Stoddard & Niederhauser, 1993). It is argued that an ILS fits readily with traditional approaches where instruction essentially involves the transmission of information (Cohen, 1990) and students are to master and replicate the knowledge and skills so transmitted (Duffy & Jonassen, 1991). It is also consistent with an outcomes-based philosophy of education because teachers can preset mastery levels for each individual student in every skill area (Mageau, 1992). It fits well with the subject based organisational structure of many schools (Newman, 1992).

The secondary school which chose to add an ILS lab to its normal uses of computers (which were to serve the curriculum subject concerned with computers and as a learning aid or tool in several other subject areas) did so with the notion that it would

help address a particular problem, namely, the underachievement in literacy and numeracy of a significant number of students entering secondary school. In this sense their aims were outcome-based. The mechanisms by which they hoped to achieve better outcomes included interest value (students more prepared to tackle work), individualisation and a more positive view of self as learner stemming from experience of success resulting from working at a student's own level and pace.

This innovation illustrated a number of issues with respect to successful implementation of technology. The first concerns educational integrity. This depends on the extent to which the innovation is in response to an educational need; complements and extends curricula goals and melds with and extends the school's philospophy of teaching and learning. Educational integrity, in general, was maintained by grafting the computer based learning onto an existing, successful learning support framework.

However, the effectiveness in terms of outcomes also depends on the software content and presentation. Although the majority of students commented positively on the interesting, different and fun nature of the work, there were still a number who found the extent of repetition and the pace, boring. The most favourable comments of both teachers and students were directed to sections of the programmes which clearly related to the New Zealand syllabus (Parr, 1994a). Similarly, Morrison, Gardner, Reilly and McNally (1993) found that positive associations in terms of attitudes to school work occurred largely where the process based work on the computer was seen to transfer directly to the content area of the discipline. Although

both students and teachers perceived there to be transfer of learning from the ILS work, there was no statstically significant difference in performance on school based tests or nationally normed measures. Considerable teacher time was obviously needed to acquire the detailed knowledge of the programmes necessary to maintain the optimum curriculum match for the needs of New Zealand students (Parr, 1994a).

With respect to presentation, the reaction of some staff to the underlying pedagogy of the ILS software (predominantly individualised mastery learning) illustrates the variation in teaching styles and the current state of flux as many secondary teachers move from the traditional teaching of the information (and, to a lesser extent, the skills and practices) of a content area to a consideration of the more universal processes of learning. Some teachers felt that the dominant pedagogy of the software did not blend readily with their classroom practice which was often of a constructivist nature including, for example, cooperative work. The use of ILS did accord with the school's desire to let students take more responsibility for their learning. Students perceived and commented specifically on a lack of teacher direction (Parr, 1994a). The underlying pedagogical assumptions contained in the software and the compatibility of these both with the individual teacher's beliefs and practices and the school philosophy affect the success of such an implementation.

Another factor affecting the success of any innovation was illustrated as a result of the decision, based largely on ideas of equity in terms of access, to give all students in the first and second years of high school an opportunity, albeit limited, to use the programmes on the system. This was done by utilising one of the English or maths

lessons a week. There were thus more staff involved and they had differing degrees of commitment to and expertise in the use of the ILS. It was more difficult to achieve integration, coherence and continuity. It was clear that teachers needed to develop a new set of criteria for assessing on task behaviour; new strategies for monitoring the process of practice and learning outcomes. Those staff closely involved through the learning support framework were highly committed and effective; others were, some only initially, lukewarm or even antagonistic (Parr, 1994a). An important factor which affects the successful implementation of any innovation is the support and commitment of staff and the willingness to adopt new or different roles.

This particular innovation underscored the necessity for staff to be given the opportunity to be involved in decisions at all stages of the implementation. In addition, the implemetation illustrated not only the time and training needed to utilise the programmes maximally in terms of complementing the curricula but also the experience and reflection required by the teacher to change observational practices and to utilise different diagnostic information. Finally, reactions of some teachers to the ILS system and their opposition to something perceived to signal a return to the status quo highlighted the changing pedagogy of the secondary school. The lack of definitive evidence of generalisation of learning lends support to the notion that technology may only assist in the raising of student achievement levels in concert with more fundamental changes in the processes of teaching and learning. Such a use of technology illustrates Newman's (1992) point that if technology is to assist the task of restructuring education, then it must be specifically moulded to this task.

Personal computers for students: Towards a wired school.

After embarking on various routes to the information highway, a school decided first to equip certain classes with computers for their own personal use in class and out of school hours and, later, to connect all areas of the school with fibre optic cable to a network, local and external. The school leadership seemed convinced that evidence existed of a positive correlation between use of technology and enhanced learning outcomes. At the outset there was no evidence to suggest that they were clear about the mechanisms by which the link might be effected.

Such an approach closely equates with D'Ignazio's idea of hard architecture attempts at restructuring. There have been some small scale experiments of this nature (Education 2000 and the Open School in the United Kingdom) but, according to Richardson (1993), fundamental issues of educational ideology and control have remained largely unquestioned by such projects. Such appeared to be the case with this project.

In its first year, the personal computer project illustrated clearly that computers tended to be used in ways that melded with existing practice, for example as an electronic notebook (Parr, 1992). Others have shown that a piece of tool software can be used in many different ways (Sheingold, Hawkins & Char, 1984). Different computing practices reflect different orientations and understandings of what learning is and what the roles of teachers and learners are (Lai, 1992).

Teachers play a pivotal role (Ryba, 1991). The way teachers use and feel about using

computers in their classroom is influenced by both their beliefs about computers and the role of computers, as well as their general educational beliefs (Dwyer, Ringstaff & Sandholtz, 1990; Honey & Moeller, 1990). Although it is generally accepted that technology will promote more constructivist approaches to teaching and learning (Collins, 1991) there are aspects of teachers' current thinking which may get in the way of their adopting this approach to teaching and learning (Pravatt, 1992). Such views include beliefs about the learner (individual differences in ability) and the view of the curriculum as a fixed agenda consisting of well ordered content, mastered according to pre determined criteria.

According to Rubin and Bruce (1990), the new technologies require both teachers and students to reconceptualise teaching and learning in new ways and these must be integrated with well established classroom practices. Traditional practices within a functioning social system are unlikely to change just because new practices are possible. Some feel that technology will be bent to fit existing practice or will not be used (e.g. Cohen, 1988).

The teacher's beliefs and philosophy are crucial and these are influenced by multiple sources, including training. One of the outcomes of the first year of the personal computer project was to institute wide staff development, commencing with the issue of laptops to all staff, followed by both in house and other courses The staff, as a whole, became much more frequent users of computers and much more confident personally. However, the amount of classroom usage remained constant (Parr, 1993). It may have been partly the result of the focus of professional development activities

(Parr, 1994b). According to Willis (1993), training and development activities today need a different focus and framework. Software and hardware details need to be in the background, context needs to be supported and instructional strategies and procedures foregrounded. There may have been insufficient of the latter. But, it is more likely that aspects of the school philosophy and culture, reinforcing or perhaps thwarting the beliefs of individual teachers, inhibited changed practices. According to McDaniel, McInerney and Armstrong (1993), much depends on the school's beliefs about the nature of school achievement. If mastering subject matter is a prime concern then computers will be employed in ways that maintain teacher dominance and student passivity. Computers will be used differently if achievement is seen as including student independence in seeking information and participating actively in setting and achieving learning goals. If the former concern is dominant and, in this school with its "orders" (public ranking of all students in a year group, based on exam/test results) there was evidence that it was, then, essentially, the school will be technology rich but the effectiveness of education will not be increased, nor the process of learning changed.

New kinds of curriculum; new kinds of learning: An integrated studies project and others.

An example of new kinds of curriculum and new kinds of learning was an integrated approach to the use of computers in a secondary school in the form of thematic, interdisciplinary learning drawing on the traditional subjects of geography, biology, English and computer studies. Student controlled computer applications and field trips

were key motivation, learning and personal development strategies (Ayres & Nolan, 1987).

In this case, there was a clear and acknowledged relationship between the abolition of a national exam in Year 11 and the introduction of the innovation. The idea was then introduced at Year 8 and 9 levels where there are also no national exams. However, only English and social studies (a common mix of teaching subjects for individual teachers) combined under a single teacher to allow a block of time. Maths and science integrated into a theme during major field activities and where appropriate and possible. Computers played a major role as a tool to address the learning objectives of the programme and had an impact on the type of activities developed in units of work which tended to be student centred, problem solving activities based on real life data collected and developed by the students themselves (Horton, 1991).

This innovation illustrated the operation of two factors which affect the implementation of computers and other technology into schools. One observation from this project was that the only confident and competent users in the school tended to be teachers involved in the project and the number of teachers who used computers in their teaching remained relatively small. Horton (1991) observed at the time that it is necessary to plan the extension of computer skills in a school in a systematic way. However, as the previous case study illustrated, the issue is far more complex than extending computer skills amongst staff. More significant perhaps was the second factor, namely, organisational constraints. Both curriculum constraints of national examinations and timetabling constraints in schools carefully structured on a subject/

time slot basis mitigate against use of technology in an open ended fashion. The compartmentalisation of subjects in the curriculum, paralleled by teacher training in specific subject areas hinders an open, cross curricula approach to learning, one which computers readily support.

In primary schools there is evidence of computers being used as a support for new curricula and new ways of learning. Historically, in primary schools there are fewer resources for technology and many fewer machines per school. This lack of machines, coupled with the acceptance of the idea that they be mobile, has basically two outcomes. The first, and by far the most common, is that the computer is used as a resource. The other is that it is used as a remedial teaching device or, alternatively, as a reward for diligent or achieving students. From the outset, most New Zealand primary teachers were quick to reject the drill and practice software or any software which reflected an instructional or didactic approach (Falloon, 1993). The emphasis in the training of primary teachers on whole language and cross-subject, themactic units of learning also contributes to the approach taken with respect to computers. Primary teachers are less accustomed to both compartmentalised subjects and a highly regulated school day. The computer is a resource which might be used for collecting and analysing class data in a study of pets; as an information source about pets, and as a means of presenting text, graphic and sound information on the subject.

Falloon (1993) presents case study examples from primary schools where computers were used as a natural part of the whole learning process, like using "Mickey's Space

Adventures" in a study of the solar system or "Goldfields Interactive Fiction" to study how people lived and met their needs in times of hardship and when making decisions. In these examples, the information gained from working with the computer software was very often the basis and the motivation for other, off computer activities.

There are, briefly, some other examples of Silverman's (1991) idea of new kinds of education. These include the use of telecommunications for information gathering; for personal and career development through mentoring, and telelearning as an alternative to correspondence school. Recent initiatives by the Ministry of Education include exposing schools in certain, largely urban areas, to some of the implications of technology by linking them to an electronic network. Location is an important factor in access to such initiatives. Watson (1990) talks of the trickle up theory whereby national and state leaders may eventually link schools to the information highway but only after there has been a groundswell. That ground swell is underway.

Some schools have grafted onto their existing computing structures a bush track to the information highway. A technologically oriented approach to search and retrieval of information has been instituted by six Christchurch schools who have developed a fax based information network they call CIN (Current Information network) whereby they share articles from magazines and newspapers and vertical file material. Such a system is changing behaviour to a more technologically assisted search strategy, according to Zwimpfer, the business futures and strategic markets general manager for Telecom (New Zealand InfoTech Weekly, 1994). A few schools have very recently equipped themselves as full internet sites at considerable initial and ongoing cost.

Most schools have not the resources to do this. Schools who prefer have joined a managed network like Learning Link. This emphasises the fact that a considerable amount of expertise, largely in the form of experience, is required to utilise a network optimally. To date, there is no research evidence of outcomes from such implementations.

Technology is also being utilised to allow students from seven small secondary schools in the rural areas of Canterbury to study subjects which they might be the only student in their school opting for and which would, normally, be uneconomic to teach. Usually in such cases the only option is correspondence. Tele-learning is used so the lesson is on-line via audio graphics.

O'Rourke (1994) talks of distance learning, in the sense of "putting the best teachers in front of students of any age in any location" (p.32), as happening through technology. Although this example is, arguably, a case of presenting the same content, both the institutional structure and the means of delivery are radically different. The classroom has been replaced as the point of instruction.

Conclusion

Although computers and associated technology are seen as educational reform measures, both in terms of ensuring a competent workforce for a technological era and as a means of transforming educational practice, an array of factors mediate progress towards these goals.

In New Zealand, the historical context of introduction initially placed computers in a

compartmentalised curriculum area, symbolically physically separate from classrooms, restrictions not yet entirely discarded. Even before the advent of devolved management, New Zealand schools lacked access to policies which might provide direction in terms of implementing technology (Hodson, 1992). Implementation has not only lacked consistent central direction but also the provision of resources- hardware, software, curriculum development, professional development and co-ordinated expertise sharing. There is evidence of a lack of planning in terms of identifying the educational issue and the mechanisms by which technology may help. A central issue in the successful implementation of change is to identify and analyse the problem to be solved (Levinson, 1990). And the type of technological solution (for example the ILS) may have limited acceptance and success because rather than reinforcing a didactic paradigm, it highlights its inadequacies in a changing situation, pedagogically.

Such barriers to successful implementation remain to a greater or lesser extent. Most New Zealand schools have acquired computers, if insufficient peripherals and software; expenditure patterns suggest an emphasis on hardware and it is doubtful whether financial resources and planning will allow continued upgrading and expansion. Professional development of a teaching force, previously largely self taught, has received some government support.

However, while it is clear that the hard architecture approach in terms of providing sufficient, readily accessible technology is, in itself, not a reform, neither need the coupling of this with professional development change educational practice. There are further moderating variables. One of the foremost is the difficulty of "retrofitting

technology to the existing structures of education" (Butzin, 1992, p330). Currently, we "implant" the technology of the 1990's onto a pre technological educational ideology, onto a curricula, teaching and learning practice and a use of space and resources which is a post war reconstruction legacy (Richardson, 1993).

Classrooms are well established cultures with social organisations and work related goals embodied in longstanding curricula (Sheingold, Hawkins & Char, 1984). Factors such as a close adherence to a common, largely subject based curriculum with an emphasis on testing and learning in order to perform in those tests, may impede teacher's desire and attempts to change classroom practices. Further, the current emphasis on accountability and its manifestation in the form of common objectives and curricula and measurable levels of attainment serves to reinforce a traditional, transmission approach to teaching. Features of the organisation for learning such as the division of the school day into fixed time slots, the division of labour whereby secondary teachers see themselves as responsible for teaching the content area of a "subject" make it difficult to accommodate an essentially open ended tool for learning.

Thus, school and classroom organisational structures; the way the curriculum is organised; assessement practices and the culture of teaching, including the beliefs of teachers, impact on what response is to an innovation. Organisational theorists (e.g. Weick, 1976, cited in Butzin, 1992) maintain that while it is relatively easy to adopt changes at the periphery, it is difficult to make widespread and significant changes to an organisation. The web is complex. At times the organisational or school culture is

in accord with teachers' desire to retain traditional didactic methods of teaching and classroom practice. Inevitably the innovation is co-opted, that is modified to meet the needs of the school system. On the other hand, organisational factors such as timetabling, common testing, ease of access to technology and support and allocation of resources may hamper teachers' desire to move towards a learner centred environment and they may actually utilise the technology in a manner at variance with their beliefs. The most common, easily observed example of this is the primary language teacher, raised on a notion of process writing, who believes that writing is a recursive not a linear process but has very limited access to computers so uses them only for editing and producing a finished product.

As Burtzin (1992) points out, the system of education we have is an interlocking and self sustaining one. If parts are changed often other parts will pressure for return to the status quo. Saturating schools with technology and teachers with professional development may not bring about reform until the present idea of schooling, borrowed from the medieval church, of groups brought together in one place for instruction, a system undoubtedly once the most efficient way of educating the masses, is, itself, discarded. The concept of a school might become that of an organisation which, supported by technology, has as its aim the maximising of opportunities for contact between people and resources for learning (Richardson, 1993).

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